



Determination of the functional state of the body using non-traditional research methods when performing the static exercise: "Prone press ups, static top position" (Cobra)

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Abstract

The aim of the work was to determine the electrical activity of the skin when performing a static exercise "Prone press ups, static top position (Cobra)".

Material and methods. Investigation of the effect of the selected static exercise was performed using the method of determining the electrical conductivity of representative points of the human body. Ten female students of 18-20 years who perfectly mastered the technique of performing the exercise were surveyed. The measurements were performed during, after and after 6 minutes.

Results. Significant changes in indicators of electrical activity in representative points of the human body were revealed. Selected static exercise has a significant impact on the functional state of the person: according to Chinese folk medicine, stimulates the body points corresponding to the acupuncture meridians according to the classification of Chinese medicine cardiovascular, lymphatic and immune systems, colon and submucosa, mucosa spleen, small intestine.

Conclusions. During the study of the effect of static exercise, it was found that the increase of electrical activity of the human body points, which, according to the literature, are responsible for the functions of the respiratory, cardiovascular, lymphatic and immune systems, the large intestine. This exercise also causes a decrease in electrical activity at representative points of the liver, stomach, and inhibits the activity of the small intestine, spleen, and pancreas. It is possible to propose the use of methods for determining the activity of human body points for the study of the influence of static exercises on the human body, along with other generally accepted scientific methods.

Keywords: physical education, static exercise, internal organs

Анотація

Мусяненко О.В., Мяхаць Л.В., Будинкевич С.Н., Попович С.І. Визначення функціонального стану організму за допомогою нетрадиційних методів дослідження при виконанні статичного вправи: "Упор лежачи на стегнах" (Поза Кобри)

Метою роботи було визначити електричну активність шкіри при виконанні статичної вправи «Упор лежачи на стегнах».

Матеріал і методи. Дослідження впливу виконання обраної статичної вправи проводили з використанням методу визначення електричної провідності репрезентативних точок тіла людини. Обстежено десять студенток 18-20 років, які досконало володіли технікою виконання вправи. Вимірювання поводити до виконання вправи, під час та після через 6 хвилин.

Результати. Виявлено достовірні зміни показників електричної активності у репрезентативних точках тіла людини. Обрана статична вправа має досить суттєвий вплив на функціональний стан людини: згідно китайській народній медицині, стимулює точки тіла, що відповідають акупунктурним меридіанам за класифікацією китайської медицини серцево-судинної, лімфатичної та імунної систем, товстого кишечника та пригнічує функцію печінки, шлунку, підшлункової залози, селезінки, тонкого кишечника.

Висновки. Під час вивчення впливу статичної вправи встановлено підвищення електричної активності точок тіла людини, які, за даними літератури відповідають за функції дихальної, серцево-судинної, лімфатичної та імунної систем, товстого кишечника. Також ця вправа викликає зниження електричної активності у репрезентативних точках печінки, шлунку та пригнічує діяльність тонкого кишечника, селезінки і підшлункової залози. Можна запропонувати використання методики визначення активності точок тіла людини для дослідження впливу статичних вправ на організм людини поряд з іншими загальноприйнятими науковими методами.

Ключові слова: фізичне виховання, статична вправа, внутрішні органи

Аннотация

Мусяненко Е.В., Мяхаць Л.В., Будинкевич С.Н., Попович С.И. Определение функционального состояния организма с помощью нетрадиционных методов исследования при выполнении статического упражнения: "Упор лежа на бедрах" (Поза Кобры)

Целью работы было определить электрическую активность кожи при выполнении статического упражнения «Упор лежа на бедрах».

Материал и методы. Исследование влияния выполнения выбранной статической упражнения проводились с использованием метода определения электрической проводимости репрезентативных точек тела человека. Обследовано десять студенток 18-20 лет, в совершенстве владели техникой выполнения упражнения. Измерение вели к выполнению упражнения, во время и после через 6 минут.

Результаты. Выявлены достоверные изменения показателей электрической активности в репрезентативных точках тела человека. Выбранное статическое упражнение имеет достаточно существенное влияние на функциональное состояние человека: согласно китайской народной медицине, стимулирует точки тела, которые отвечают акупунктурным меридианам по классификации китайской медицины сердечно-сосудистой, лимфатической и иммунной систем, толстого кишечника и подавляет функцию печени, желудка, поджелудочной железы, селезенки, тонкого кишечника.

Выводы. При изучении влияния статического упражнения установлено повышение электрической активности точек тела человека, которые, по данным литературы, отвечают за функции дыхательной, сердечно-сосудистой, лимфатической и иммунной систем, толстого кишечника. Также это упражнение вызывает снижение электрической активности в репрезентативных точках печени, желудка и подавляет деятельность тонкого кишечника, селезенки и поджелудочной железы. Можно предложить использование методики определения активности точек тела человека для исследования влияния статических упражнений на организм человека наряду с другими общепринятыми научными методами.

Ключевые слова: физическое воспитание, статическое упражнение, внутренние органы



Introduction

Currently, in various types of health fitness, static exercises are becoming more common. These types of fitness include Pilates, stretching, yoga and others. However, the physiological effects of static exercises are poorly understood. There is empirical evidence that emphasis affects the strength capabilities of individual muscles, improves joint elasticity. However, the urgent effects of exercise are not well understood. Currently, a method is actively developing to determine the electrical activity of various points of the body (electrical activity of the skin) [1, 2, 3].

The electrical activity of the skin is a bioelectric reaction that is recorded from the surface of the skin, an indicator of the activity of the autonomic nervous system, which is widely used in psychophysiology [4, 5]. Mystobodsky, Rattok [6] showed the appearance of a greater skin reaction to visual stimuli compared with verbal stimuli, which is consistent with modern concepts of interhemispheric asymmetry.

From the point of view of electronics [4, 5], direct registration of resistance is simpler and cheaper, in connection with this, most researchers continue to use instruments that measure skin resistance, and then, using nonlinear transformations, they convert the obtained data into conductivity values. It was revealed that spontaneous activity increases with emotional stress, while level changes occur both as a result of emotions and during mental work. The level of tonic electrodermal resistance is used as an indicator of the functional state of the central nervous system: in a relaxed state (for example, in a dream), skin resistance increases, and with a high level of activation it decreases. Phase indicators sharply react to tension, anxiety, increased mental activity, conscious experiences [1, 4, 5].

This technique has analogues in traditional Chinese medicine, in particular, the determination of the activity of acupuncture points and meridians [7]. In particular, the Ryodoraku method is the basis for measuring the electrical activity of the skin, and the Japanese were divided into parts by J. Nakatani in 1950. By determining the electrical activity of points on the skin, the author means determining the activity of acupuncture meridians [7].

This method is easy to use, allows you to integrate the practical development of antiquity with modern scientific knowledge. Some studies have shown the information content of this method

in conjunction with other methods for determining the functional state of the body. In this regard, we decided to use this method to determine the functional impact on the body of the static pose "Emphasis lying on the hips".

The mechanisms of acupuncture remain poorly understood, but it is generally believed that electrical conductivity measurements at different meridians provide data representing different energies of the meridian. In the past, non-invasive methods have been used to stimulate acupuncture points at meridians [8-9], such as heat, electricity, magnets, and lasers. We have reviewed the relevant literature, looking for information about meridians, including their wave characteristics of flow.

Acupuncture diagnostics is one of the popular methods of studying the state of the organism [10–11]. A thorough study of the various methods of acupuncture diagnostics has enabled us to choose the Ryodoraku method developed by the Japanese scientist J. Nakatani in 1950 as the most informative one for his research [7].

According to him, all biologically active points are connected into meridians, each of which carries information about the functional state of an internal organ, which in subsequent studies has been confirmed by other foreign scientists [16, 17, 18].

It is traditionally believed that acupuncture meridians contain channels that connect the surface of the body to the internal organs. Twelve primary meridians are believed to be symmetrically arranged on both sides. The left and right meridians interact with each other through interconnected meridional channels [7; 18–22]. The network of meridional channels is thought to be located in soft connective tissues. Traditional Chinese medicine has described in detail the normal physiological functions, pathological conditions, the transmission of sensory organs and possible mechanisms of disease [21, 23]. The mechanisms of acupuncture remain poorly understood and require further study by scientific methods to study the nature of meridional lines and acupuncture points. It is generally assumed that the measurement of electrical conductivity at different meridians yields data relating to the so-called "meridional energy" [7].

In 1950, Dr. Yoshio Nakatani measured the electrical resistance of his patients' skin, revealing poor electrical conductivity. He found high conductivity lines that coincided with traditional meridians, he called it "Ryodoraku", which means a strong conductive line or electric path. The Ryodoraku lines were defined because



they corresponded to different classical Chinese meridional paths [7, 18].

Considering that at each meridian a large number of reactive electrically permeable points (for example, at the bladder meridian there are 67) and measuring the electrical response from each of them is a very laborious process. Nakatani [7] proposed measurements only at representative points, the average value of electrical conductivity in which corresponds to the average value of electrical conductivity of the entire meridian. According to the indicators of the magnitude of the electric current in representative points, one can conclude about the functional state of one or another organ in comparison with the physiological norm, that is, the technique is very informative in the diagnosis of diseases.

The aim of the work was to determine the electrical activity of the skin when performing a static exercise "Prone press ups, static top position (Cobra)".

Material and methods

Participants

The research involved 10 female students of 18-20 years who perfectly mastered the technique of performing static exercises and practiced them for at least one year. All students performed the exercise, which was technically correct.

Procedure

We chose the "Prone press ups, static top position" (Cobra) exercise because of its static performance and ease of study. We have assumed that the use of this technique is possible not only for the diagnosis of diseases, but also for determining the effect of exercise on certain organs and systems of the body, if measurements are taken before performing asana, during its maintenance and after a rest from its performance.

Trial studies have confirmed our hypothesis about the expediency of using the Ryodoraku technique as a method of urgent information to determine the effect of exercise on the human body. The electrical activity of the skin points was determined. The points were selected according to the Chinese medicine on acupuncture meridians. The methodology for the study of Ryodoraku by Nakatani [7] was carried out using a device similar to that described in the literature [18; 23; 24] (Fig. 1).

The study according to this method provided the following questions to be solved: 1. To investigate changes in the electrical conductivity of representative points of the human body before, during and after the exercise. 2. To substantiate the possibility of using this research methodology to determine the impact of exercise on the human body.

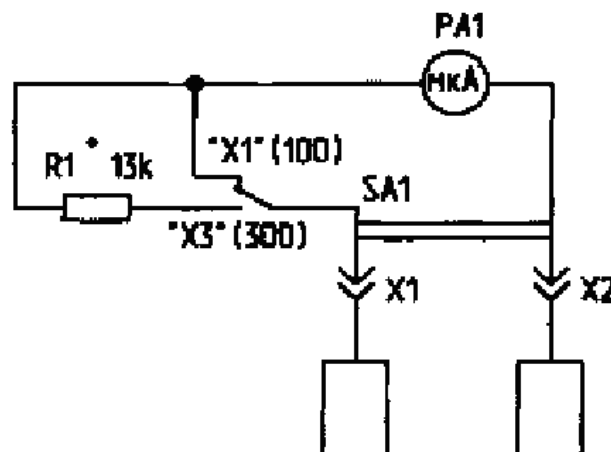


Fig. 1. Scheme of a device for measuring the electrical activity of meridians based on the determination of the electrical activity of the skin [18]

Measured electric current at representative points corresponding to the points of the twelve major meridians of Chinese medicine: lungs (P), pericardium (MS), heart (C), lymphatic and immune systems (TR), small (IG) and colon (GI) intestines, spleen and pancreas (RP), liver (F),

kidney (R), urinary (V) and bile (VB) bladders and stomach (E) to determine the possibility of studying the effect of exercise on the body by methods of diagnosis of electrical activity of the skin.

During the studies of the effect of static exercise "Emphasis on lying on the hips" (Fig. 2) on the human body posture retention lasted 10 minutes, rest after its execution - 6 minutes. The rest was done on the back with the maximum relaxation of all muscles. The exercise was performed during physical education classes under the guidance of the teachers of the Physical Education Department under our program.

Results

An analysis of the dynamics of acupuncture diagnostics showed (Table 1, Fig. 3): this exercise has a greater or lesser effect on all organs that were examined.

In the meridian P, while holding the posture, it was recorded, albeit insignificant, by 13.7%, but significant, an increase ($p < 0.05$) of EP.



Fig. 2. Static exercise "Prone press ups, static top position (Cobra)"

After the exercise, there was a sharp increase in EP, its indicators increased to $9.5 \pm 0.2 \mu\text{A}$, which is 86.3% of the increase from the initial level and characterizes a significant activation of respiratory function (table. 1). A similar (in the nature of activating the organ) picture is observed in the meridian of MS. During posture retention, EP increases by 50.0% ($p < 0.01$), and after performing by another 17.9% ($p < 0.05$).

In the meridian C, the performance of asanas decreases the EP values by $1.05 \pm 0.1 \mu\text{A}$, but after their execution significantly increases and makes the total increase from the initial level by 46.2% ($p < 0.01$), indicating cardiac activation. - Vascular system.

Activates the activity of the lymphatic and immune systems. The EP indicators increase during the performance of the post by $2.6 \pm 0.1 \mu\text{A}$, after its performance by another $1.65 \pm 0.1 \mu\text{A}$, which is an overall increase of 111.8% ($p < 0.01$).

The activity of the small intestine is somewhat inhibited. In the IG meridian, the EP values decrease during posture, increase after its performance, but do not reach the initial level of 5.5%.

In the GI meridian, on the contrary, the indicators increase during asana performance, after rest they decrease, although they remain higher by 22.6% ($p < 0.05$) compared to the initial level, which indicates stimulation of colon activity.

In the meridian of RP, the EP values increase by 12.5%, but after rest they decrease by 21.5% ($p < 0.05$) and do not reach the initial level, thus reducing the function of the spleen and pancreas. The function of the liver of Bhujangasana's performance is practically unaffected. During the execution of the EP position it decreases significantly - by 58.0%, after the performance it increases by 57.2%, ie its indicators are approaching the initial level. The difference between the indicators before and after the exercise was not significant ($p > 0.05$).

In the meridian, R during the performance of EP poses significantly decreases ($p < 0.05$) by $1.3 \pm 0.08 \mu\text{A}$, after rest significantly increases and is a total increase of 20.8% ($P < 0.01$), ie kidney function is activated.

Indicators of EP in the meridian V gradually decrease, characterizing the decrease in the function of the bladder both during and after the posture. The overall decrease in EP is 28.5% ($p < 0.01$).

In the VB meridian, the EP values decrease by 39.0% ($p < 0.05$) compared to the baseline data, ie, asana performance suppresses the activity of the gallbladder.

The function of the stomach, as well as the liver, is virtually unaffected by Bhujangasana. No significant differences were found between EP scores before and after the exercise.

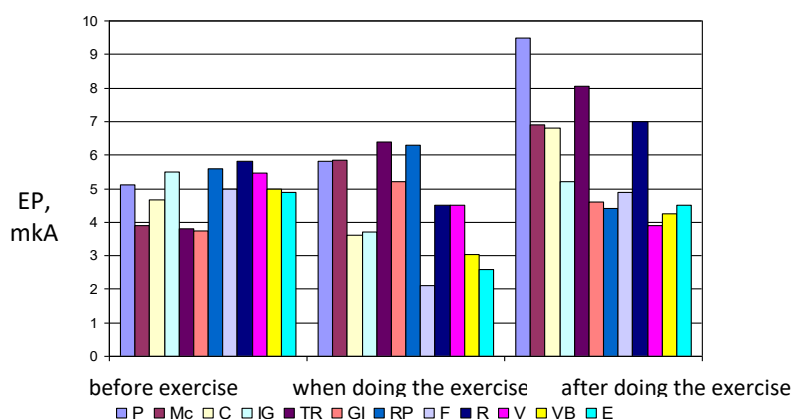


Fig. 3. The chart of indicators of acupuncture diagnostics (mA) before, during and after the exercise «Prone press ups, static top position» (Cobra) :

P - points of the skin, which according to Chinese medicine correspond to the meridian of the lungs; MS - points of the skin that according to Chinese medicine correspond to the meridian of the pericardium; C - points of the skin, which according to Chinese medicine correspond to the meridian of the heart; TR - points of the skin that according to Chinese medicine correspond to the meridian of the lymphatic and immune systems; IG - skin points that according to Chinese medicine correspond to the meridian of the small intestine; GI - points of the skin that according to Chinese medicine correspond to the colon of the colon; RP - points of the skin that according to Chinese medicine correspond to the meridian of the spleen and pancreas; F - points of the skin, which according to Chinese medicine correspond to the liver meridian; R - points of the skin, which according to Chinese medicine correspond to the kidney meridian; V - points of the skin, which according to Chinese medicine correspond to the bladder meridian; VB is the gallbladder meridian; E - points of the skin, which according to Chinese medicine correspond to the meridian of the stomach

Table 1

Dynamics of electrical activity of skin points (μ A) before, during, and after performing a static thigh resting exercise

Num ber	Indicators	Before exercise		When doing the exercise				After doing the exercise					
		\bar{x}	m	\bar{x}	m	t1	p1	\bar{x}	m	t2	p2	t3	p3
1	P	5,1	0,26	5,8	0,36	2,27	<0,05	9,5	0,2	3,48	<0,01	3,52	<0,01
2	Mc	3,9	0,16	5,85	0,19	3,27	<0,01	6,9	0,26	2,54	<0,05	3,43	<0,01
3	C	4,65	0,24	3,6	0,26	3,28	<0,01	6,8	0,22	3,54	<0,01	3,74	<0,01
4	IG	5,5	0,2	3,7	0,17	3,26	<0,01	5,2	0,22	3,62	<0,01	2,89	<0,05
5	TR	3,8	0,22	6,4	0,26	3,29	<0,01	8,05	0,42	3,51	<0,01	3,29	<0,01
6	GI	3,75	0,22	5,2	0,22	3,28	<0,01	4,6	0,16	2,48	<0,05	2,45	<0,05
7	RP	5,6	0,16	6,3	0,17	2,35	<0,05	4,4	0,16	3,67	<0,01	2,68	<0,05
8	F	5	0,31	2,1	0,29	3,3	<0,01	4,9	0,21	3,62	<0,01	0,84	>0,05
9	R	5,8	0,22	4,5	0,24	2,29	<0,05	7	0,31	3,32	<0,01	3,84	<0,01
10	V	5,45	0,28	4,5	0,31	3,41	<0,01	3,9	0,29	2,75	<0,05	3,67	<0,01
11	VB	5	0,24	3,05	0,28	3,28	<0,01	4,25	0,31	2,78	<0,05	2,46	<0,05
12	E	4,9	0,35	2,6	0,43	3,29	<0,01	4,5	0,42	2,35	<0,05	0,97	>0,05

Notes: p1 - reliability of discrepancies between performance and posture performance; p2 - reliability of discrepancies between indicators during and after the posture; p3 - reliability of differences before and after performing the posture; t1 - Student's t test calculated for indicators before and during the exercise; t2 - Student's t test calculated for indicators during and after the exercise; t3 - Student's t test calculated for indicators before and after the exercise; P - points of the skin, which according to Chinese medicine correspond to the meridian of the lungs; MS - points of the skin that according to Chinese medicine correspond to the meridian of the pericardium; C - points of the skin, which according to Chinese medicine correspond to the meridian of the heart; TR - points of the skin that according to Chinese medicine correspond to the meridian of the lymphatic and immune systems; IG - skin points that according to Chinese medicine correspond to the meridian of the small intestine; GI - points of the skin that according to Chinese medicine correspond to the colon of the colon; RP - points of the skin that according to Chinese medicine correspond to the meridian of the spleen and pancreas; F - points of the skin, which according to Chinese medicine correspond to the liver meridian; R - points of the skin, which according to Chinese medicine correspond to the kidney meridian; V - points of the skin, which according to Chinese medicine correspond to the bladder meridian; VB is the gallbladder meridian; E - points of the skin, which according to Chinese medicine correspond to the meridian of the stomach



Discussion

The results of studies show that in the case of technically correct exercise, according to the analysis of points of electrical activity of the skin and their comparison with meridians according to Chinese medicine, the function of the respiratory, cardiovascular, lymphatic and immune systems, the large intestine is activated. It promotes the rest of the liver, stomach and inhibits the activity of the small intestine, spleen and pancreas, which does not match the literature [4; 12], which indicates the stimulating effect of exercise on these organs. This exercise also contributes to a gradual increase in spine mobility, an increase in elasticity of the ligaments, which makes the subjective exercise easier to perform.

In addition, observations and practical experience suggest that asana contributes to the development of spine flexibility in all its departments.

The results obtained indicate a significant ($p < 0.05$) change in the electrical activity of skin points due to static exercise. It is possible to assume the possibility of conducting studies of the influence of various static physical exercises on the human body using the method of estimating the electrical activity of skin points corresponding to the meridians of the human body according to Chinese medicine.

During the exercise «Prone press ups, static top position» (Cobra) the characteristics of electrical activity of the skin are determined, which explains to some extent the effect of the exercise on the functioning of the internal organs. Therefore, performing this exercise significantly activates the function of the small and large intestine, liver, kidneys and adrenal glands, immune and lymphatic systems, reproductive glands. Performing this exercise inhibits activity, that is, promotes respiration of the respiratory system, cardiovascular system, spleen and pancreas, urinary and gall bladder, stomach.

Unfortunately, the results of our studies are difficult to compare with those of other researchers, because in existing sources [5; 20; 21] there is insufficient scientific data on studies of the electrical activity of skin points by analogy with meridians in Chinese medicine.

Based on the opinion of the authors [7; 22; 23], the effect of the performance of Hatha Yoga asanas (which are also static exercises) on the body is due, in particular, to changes in the position of the internal organs when the position of the body is

changed or the blood flow in different parts of the body is changed with a change in posture. Thus, while performing Padmasana, the blood vessels of the lower extremities of blood flow become more intense in the visceral organs, which leads to changes in their functioning.

The results of the conducted researches make it possible to understand that the static exercise "Emphasis lying on the hips", similar to the Cobra posture in Hatha Yoga, has a rather significant effect on the human body. In order to gain a deeper understanding of the mechanisms of the processes that occur in the human body during this exercise, it is necessary to continue the study using other methods of study. We also consider it expedient to further study the impact of other available static exercises and similar Hatha Yoga asanas as a method of acupuncture diagnosis and using other techniques.

Conclusions

1. As a result of the conducted researches it is established that the method of diagnostics of the functional state chosen by us allows us to determine the electrical activity of skin points by analogy with determining the meridians of a human body while performing static physical exercises.

2. During the study of the influence of static exercise "Prone press ups, static top position (Cobra)" was found to increase the electrical activity at the points of the skin corresponding to the meridians of the human body according to Chinese medicine, which, according to the literature, are responsible for the functions of respiratory, cardiovascular, lymphatic and the immune system, the large intestine. This exercise also causes a decrease in electrical activity at representative points of the liver, stomach, and inhibits the activity of the small intestine, spleen, and pancreas.

3. It is possible to propose the use of the method of determining the electrical activity of skin points by the method studied to determine the effect of static exercises on the human body, along with other generally accepted scientific methods.

Conflict of interest

Authors state that there is no conflict of interest.



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